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Reinforcement of Soil using Some of The Different Types of Geogrids: A Review

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***Abstract*—The strengthening of soils having poor engineering properties is a common technique of ground development. The usage of polymeric materials is one strategy. A well-known method of soil reinforcement is application of geosynthetics. When compared to standard designs, using these different geosynthetics can significantly improve soil and reduce expenditures. In this paper, a review of experimental tests carried out by different previous researchers on reinforced soil with synthetic materials especially conventionally available geogrids, coir geogrids and 3D printed geogrids had been made.**

Keywords*— *Geosynthetics; geogrids; experimental test

I. INTRODUCTION

When there is a higher proportion of problematic natural soil involved in the project, replacing it with good soil according to normal practice is too expensive. The utilization of geosynthetics among the various ground improvement techniques has grown significantly in popularity in recent years as a result of their simplicity in construction, ability to maintain quality, and time-saving feature. The soil usually has the characteristics of low tensile strength and is highly dependent on environmental conditions (Ling *et al.* 2003).

The use of synthetic materials, also known as geosynthetics, was one of the best approaches. Several aspects of the geotechnical engineering process have been improved by geosynthetics, and in some cases, these applications have completely replaced conventional building materials. The use of geosynthetic in many cases, it can significantly improve performance, increase safety, and reduce costs compared to a conventional design (Boushehrian *et al.*, 2011).

The geosynthetics that are often used in construction are geofoam, geotextile, geomembrane, geogrid, geonet, geocomposites and geocell. Geosynthetics have been successfully used in several areas of civil engineering including railroads, roadways, airports, retaining structures, embankments, landfills, dams, etc. (Han, 2011).

The biggest advantage of using geogrids is that they are durable. Another important advantage provided by geogrid is helping in prevention of soil erosion. When used for construction purposes, geogrids play a dual role of easing the processes and helping in land optimization.

II. LITERATURE REVIEW

In 2013, Mohsen et al. studied the Effect of Geogrid Reinforcement on Bearing Capacity Properties of Soil under Static Load. Several factors that can affect the efficiency a geogrid reinforced soil foundation (RSF), including: (1) The Depth of first layer reinforcement under shallow foundation (2) Spacing between layers of reinforcement (3) Number of reinforcing layers and (4) Reinforcement width were investigated in that study. It was observed that the ultimate bearing capacity of shallow foundation increases with decreasing depth. Also the(Bearing Capacity Ratio) BCR improved with increasing number of reinforcement layers and by reduction vertical spacing between layers. With increasing the number of reinforcement layers it increased the BCR value. Placing geogrid reinforcement more than the depth of 1.5B cannot significantly increase the bearing capacity. The rate of bearing capacity ratio (BCR) increased with the increasing number of geogrid layers until N= 3 and then the rate of load improvement becomes much less. As the geogrid's width was increased, the effectiveness of the reinforcement in reducing the maximum footing settlement decreased.

By using 3D printed geogrids Arab et al. (2020) looked into the new possibility of using printed geogrids in reducing the settlement of soil.

In his research, a bio-inspired geogrid shape, from the concept of honeycomb structure was investigated and compared with conventional commercial geogrid. In his conclusions, the proposed honeycomb inspired geogrid demonstrated enhanced soil confinement behavior due to its unique shape. This technology can help geotechnical engineering to understand the mechanical behaviour of new geometries and design of new geometries. The comparison has revealed that the proposed geogrid has shown superior behaviour compared to the commercially available geogrid.

Amurane et al. (2019) investigated several 3D printed geocell geometries for soil improvement. In their study numerical analysis was conducted to compare the experimental results with physical model results. It was concluded that as the aperture size in the geocell increases the arching affect and in result enhances the distribution of the stresses below the 3D printed geogrid.

In a series of tests, Lal et al. (2017) looked at adding coir geogrid would increase bearing capacity of soil. For his study

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locally available, poorly graded sand was taken by him. His paper reports a detailed comparative study of the performance of different forms of coir geotextiles (i.e. geocell and planar forms) on the load–settlement characteristics of sand beds under a square footing, with the amount and characteristics of the geotextile kept the same. The woven coir geotextiles used for the present study were procured from Central Coir Research Institute, Alappuzha, Kerala, India and coir geocells were fabricated by cutting the geotextile to small strips and stitching it with coir yarns to obtain a honeycomb layout. From the results, it was clearly understood that coir geocell is the most efficient reinforcement form. Its superior performance is due to the ability of geocells to restrain the soil within the walls and distribute the pressure applied to a larger depth. The applied pressure on the footing will be carried by the geocell even after shear failure of soil, due to rigidity of the whole system. For the same amount of reinforcement used, coir geocell offers higher performance characteristics compared to planar forms.

III. CONCLUSION

The following conclusions are obtained from the literature study

- With an increase in the number of planar reinforcement layers and the reinforcement width, the bearing capacity of the foundation increases and the shallow foundation settlement decreases.
- When the first layer's depth to the footing dimension ratio equals 0.5, geogrid's effect is essentially nonexistent.
- The reinforcement's efficiency in reducing the maximum footing settlement reduced as the width of geogrid were increased.
- For the same amount of reinforcement used, coir geocell offers higher performance characteristics compared to planar forms.
- The comparison has revealed that the proposed printed geogrid has shown superior behavior compared to the commercially available geogrid.

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